ABSTRACT

Biomagnetic Scanning Of The Human Heart: Comparison Of Heart Rate Variability Indices In Time Domain Correlation Analysis Of Magnetic And Electrical Cardiac Data

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Heart rate variability (HRV) and contactless recording of biomagnetic changes today provide new methods of evaluating cardiac function, and hence a novel method for developing diagnostic criteria for use in modern medicine. This thesis introduces new methods of analysis for the results of electrocardiogram (ECG) and cardiac biomagnetic scanning (magnetocardiogram (MCG)).

Dynamic time domain correlation analysis was applied to instantaneous heart rate traces obtained from ECG and MCG recordings and the correlation between the low frequency and integrated amplitude high frequency component is investigated as an index of HRV for adults. Single-channel adult ECG data compilation is used as a proxy for single-channel MCG in some instances. In the case of the MCG, heart-rate data recorded for adults at rest and two at-term singleton foetuses of normal subjects were used. The coefficient of correlation between the selected components was compared to HRV measures SDANN index, LF/HF and Lempel-Ziv entropy estimate in assessment of two groups of 34 normal and 19 diabetic adults.

The correlation between the components was >0.7 for all of the adult subjects at rest. A reduction in correlation between the components was observed at the onset of physical exercise for all adult subjects. The reduction was significantly larger for the diabetic group than the non-diabetics (t(17)=2.715, p=0.0073). In addition distinct patterns of grouping for diabetic and normal females in principal component analysis of variables for mild exercise was observed indicating utility of the time domain correlation method in discriminating between diabetic and non-diabetic females. A more frequent occurrence of ectopic beats in diabetics giving an apparent deviation from the mean instantaneous heart rate during exercise compared to non-diabetic subjects was observed. While the implication without previously diagnosed cardiac disease is unknown, in view of the risk of cardiac morbidity associated with diabetes the finding may be significant.