Changes in integral body surface potential maps in healthy subjects during the stress test.

Jana Svehlikova

Institute of Measurement Science SAS, Bratislava, Slovakia

Email: jana.svehlikova@savba.sk

Introduction. Local repolarization changes (e.g. during ischemia) are reflected in integral body surface potential maps (IBSPMs) of the STT interval. In simulation study we suggested a method for identification and localization of local ischemic lesions from difference IBSPMs using the inhomogeneous torso model and the geometrical model of heart ventricles. The activation propagation was simulated by cellular automaton and ischemic lesions were modelled by shortening the action potential duration by 20% in selected areas of the ventricles. The difference IBSPM was computed by subtraction of IBSPM without manifestation of ischemia from the IBSPM during ischemia. It was supposed that for real patients such data can be obtained from ECG measurements performed before and during the stress test. However, during the stress test there is a considerable increase of the heart rate (HR) while in simulations no HR changes were considered. In this study the IBSPMs of healthy subjects were computed before and during the stress test and the changes in IBSPMs due to HR increase were investigated.

Methods and Materials. BSPMs from 64 measured leads were computed during the stress test on 12 volunteers (age 30-53) with no cardiac disease history. Simultaneously, the 12-lead ECG was measured to evaluate the measured data in a standard way. During the test, the HR of each subject increased from the basal value at rest up to the value higher than 85% of the value 220-age at the top of the exercise. The IBSPMs from STT time interval were computed for each subject at the basal and at the highest HR as well as for three steps in between (together in 5 levels of HR). The IBSPMs at each HR level were computed from signals averaged over intervals of 10 seconds. Because of the changes in STT interval duration with increasing HR, the IBSPMs were normalized by dividing them by the length of the corresponding STT time interval. At each level of the HR the root-mean-square (rms) signal of the IBSPM was computed as well as its correlation with the IBSPM measured at rest (at the beginning of the exercise). The differences in IBSPMs at observed levels of the HR were evaluated for each subject.

Results. The increasing HR shortened the STT interval significantly (by 30 to 50 %). The correlation coefficient between the IBSPM at rest and IBSPM at the top HR was higher than 70%. The rms value of the IBSPM at the top HR varied significantly for different subjects from 43% to 126 % of the rms value of the IBSPM at rest.

Conclusions. Remarkable differences in STT IBSPMs at rest and during the stress test were observed in healthy subjects. Similar differences can also be associated with repolarization changes in ischemic patients. Therefore for ischemic patients we cannot assign all changes in IBSPM during the stress test to pathological repolarization changes and it is questionable whether the simple difference IBSPM computed from the IBSPM at rest and at the top of stress can be used as input data for their inverse localization. Additional properties of IBSPMs should be searched for distinguishing between normal physiological changes and pathological repolarization changes during the stress test.