Evaluating the Effects of Respiration, Body orientation and Heart rate on Body Surface Potentials in Healthy Controls

Deepthi P. Chandrasekaran[1,2*], Iris van der Schaaf [1], Peter Loh[1], Johan De Bie[2], Peter M. van Dam[1], Manon Kloosterman[1]

Department of Cardiology, University Medical Center Utrecht, Utrecht, the Netherlands

Department of Electrical, Electronic, and Information Engineering, University of Bologna, Italy

***Introduction**:*The assessment and interpretation of body surface potentials during follow-up of patients with inherited cardiomyopathies is complicated by external factors such as breathing, body orientation and various heart rates. In this study we investigated the influence of these confounding factors on the body surface potential maps (BSPM) of healthy controls.

***Methods**:*67-electrode BSPM were obtained in healthy volunteers during inspiratory and expiratory hold, a 45 degrees of reclined body position and exercise-increased heart rate. We computed QRS and STT difference maps under aforementioned conditions, compared to the resting supine condition. We determined the median range (mVms) from leads with a maxima and minima, of QRS and STT difference maps and visualized the location and occurrence of the maximum (positive and negative) difference on a generic torso model.

***Results**:*Five females and five males with a median age of 28 years were included in this study. The heart rate was increased after exercise with a median value of 24 beats per minute. For all conditions, the highest potential difference was observed in the left sided leads **(Figure 1).** In the QRS difference map, the biggest difference was observed during inspiratory hold (80mVms) followed by an increased heart rate (65mVms), expiratory hold (29mVms) and a reclined body position (25mVms). In the STT difference map, a similar potential difference was observed during inspiratory hold (122mVms), increased heart rate (122mVms) followed by a reclined position (36mVms) and expiratory hold (29mVms).

***Conclusion**:*The inspiratory hold and increased heart rate had the greatest influence on the body surface potentials. At present we are analyzing the difference maps in depth by comparing crucial parameters such as R, S, T amplitudes to achieve a comprehensive validation.These results may help to differentiate between disease progression and normal variations in consecutive body surface potentials in our ongoing BSPM-study in patients with inherited cardiomyopathies.

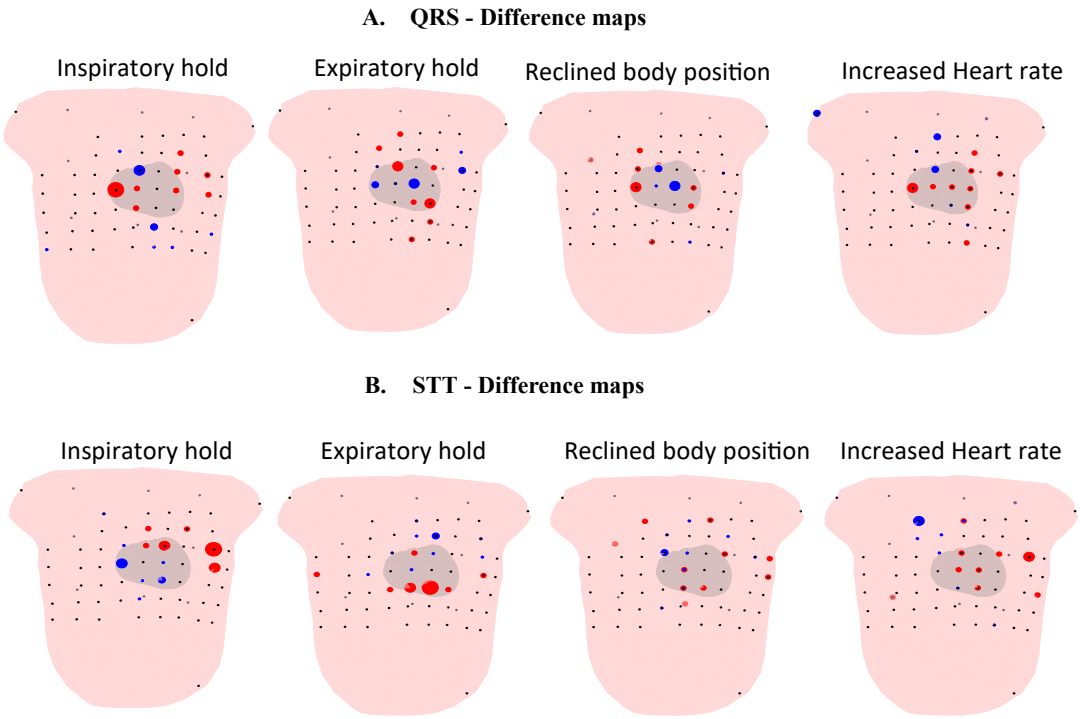

Figure 1. A general torso model is displayed to indicate the location and the occurrence (latter is represented by the size of the dots - smallest dots - 1/10 subjects, largest dots - 3/10 subjects) of the maximal negative difference (blue) and maximal positive difference (red) in A. QRS and B. STT difference maps in ten control subjects. Each torso model represents a different condition (inspiratory hold, expiratory hold, reclined position and increased heart rate). The heart contour is displayed in gray and the 67-electrodes are displayed as black dots.