Disease-specific electrocardiographic lead positioning for early detection of arrhythmogenic right ventricular cardiomyopathy

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Background | Arrhythmogenic right ventricular cardiomyopathy (ARVC) is an inherited disease characterized by progressive replacement of cardiomyocytes by fibrofatty tissue which can lead to heart failure or sudden cardiac death. Genetic defects in desmosomal proteins, with plakophilin-2 (PKP2) being the most frequently affected gene, contribute to disease development. Depolarization abnormalities are often the first sign of the disease, even prior to significant structural abnormalities. Early detection might be aided by optimal lead configuration, like in Brugada syndrome. Therefore, this study aims to identify optimal lead configurations to detect electrocardiographic changes in (a)symptomatic PKP2 pathogenic variant carriers.

Method | Sixty-four-lead body surface potential maps (BSPM) were obtained in PKP2 pathogenic variant carriers meeting the Task Force Criteria (TFC) for ARVC (ARVC group, n=7), PKP2 pathogenic variant carriers (PKP2 group, n=16) and control subjects without structural heart disease (control group, n=9). QRS-integrals and QRS-peak-to-end-integrals were determined and compared between groups using departure mapping, to identify leads with significant differences between PKP2 carriers and controls. The difference is considered significant if the difference exceeds two standard deviations from the normal range of controls.

Results | In Figure 1, the departure maps of QRS-integrals and QRS-peak-to-end-integrals are shown. As can be observed, four out of seven ARVC patients show significantly different QRS-integrals in leads above V4-V5 compared to controls. For QRS-peak-to-end-integrals, significant differences were displayed in all seven ARVC patients. In the PKP2 group, 25% showed significant difference in QRS-peak-to-end-integrals in the lead above V4.

Conclusion | In both study groups a higher left precordial lead placement than the conventional V4-V5 lead positions shows significant differences compared to controls. The results suggest a higher diagnostic value of disease-specific lead configurations. Future research will explore clinical interpretation of the results and will focus on the BSPM distribution of electrocardiographic features presented in TFC for ARVC.

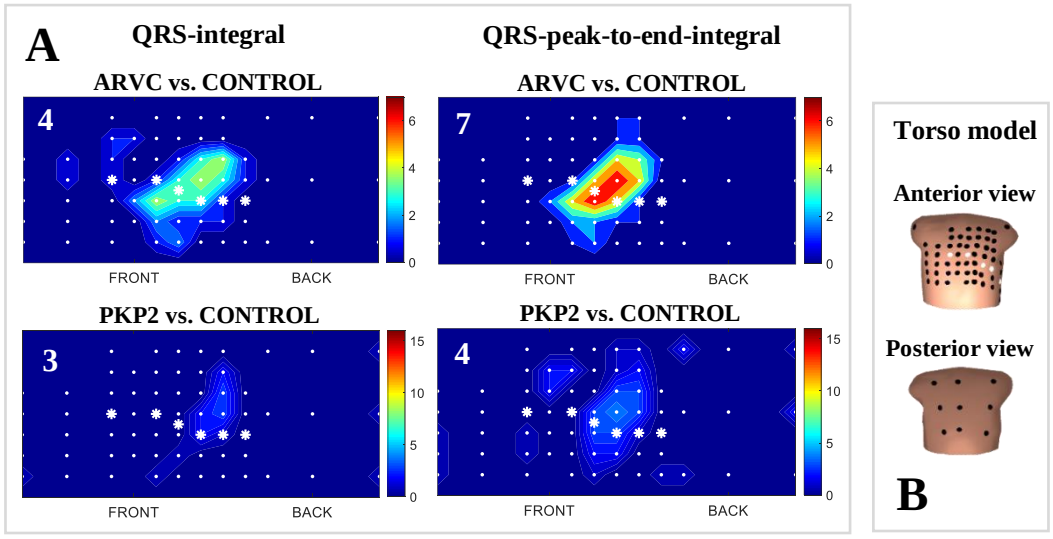

Figure 1 – (A) Summed individual departure maps that visualize the areas with significant differences for seven ARVC patients compared to the control group (upper row) and sixteen PKP2 carriers compared to the control group (bottom row). Both total QRS-integral (left) and QRS-peak-to-end-integral (right) were compared between groups. White dots represent 64 body surface potential map (BSPM) lead locations and white stars represent conventional 12-lead ECG positions. Values in left-upper corner represent maximum number of individuals that show significant differences within the summed individual departure map. (B) Torso model that visualizes the 64 BSPM lead locations (black) and conventional 12-lead ECG positions (white) in anterior and posterior view.