

PREDICTION OF VENTRICULAR TACHYCARDIA BASED ON INDICES OF VENTRICULAR REPOLARIZATION IN PATIENTS WITH AND WITHOUT PREVIOUS MYOCARDIAL INFARCTION

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Abstract: Characterisation of the body surface ECG expression of the electrical remodeling phenomena which are associated with ventricular arrhythmias is needed in order to understand their nature and variability.

We used averaged BSM data in normal subjects, patients with history of ventricular tachycardia (VT) without myocardial infarction (MI), MI patients free of VT and MI patients with a history of sustained VT.

PCA1,2,3 indices were computed by dividing the 1st, 2nd and 3rd eigenvalue to the sum of all eigenvalues resulting from principal component analysis of the ST-T potentials. Early and late repolarization deviation indices were obtained by computing the average deviation of instantaneous repolarization patterns from the pattern at the peak of T during S-Tpeak and Tpeak-Tend intervals.

When corrected with gender and age group, the PCA1 was significantly lower and PCA3 was higher in VT patients (both non-MI and post-MI subgroups) compared to MI patients without VT. LRDI was also significantly higher in MI patients with history of VT.

INTRODUCTION:

A variety of pathological conditions may lead to numerous types of arrhythmogenic processes resulting in potentially malignant arrhythmias.

It seems reasonable to expect that most of these processes will involve, at some point, some electrical remodeling phenomena which are associated with vulnerability to arrhythmias.

Identification and characterisation of these phenomena is an essential step in understanding the nature and variability of arrhythmogenic processes.

In part, the difficulty of this task arises from the added variability of the thorax conductor [1]. Numerical transformations of myocardial repolarization potentials that are invariant to features of the thorax conductor [2] may detect

varieties of repolarization heterogeneity which are arrhythmogenic.

The purpose of our study was to evaluate the ability of principal component analysis and deviation indices to reveal vulnerability to ventricular tachycardia (VT).

METHOD:

We used 259 averaged body surface map recordings of sinus beats in normal subjects, 257 in old myocardial infarction (MI) patients without a history of ventricular tachycardia (VT), 119 in MI with VT and 69 in subjects with recent history of VT but no MI. Different analyses of this dataset have been previously reported [3,4].

In this study we computed the ratio of the 1st, 2nd and 3rd eigenvalue to the sum of all eigenvalues from principal component analysis of the matrix of repolarization potentials in time [5,6]. These ratios are called PCA1, PCA2 and PCA3, respectively. We also computed the early repolarization deviation index (ERDI) as the average correlation coefficient between instantaneous potential distributions at each instant in the S-Tpeak interval and that at T peak, and likewise the late repolarization deviation index (LRDI) between T peak and T end [7].

RESULTS.

As expected on the basis of a previous investigation in normal subjects [8], ERDI was higher in normal females (F:0.294 (0.163), M: 0.118 (0.092, $p<0.00001$) and LRDI was higher in normal males (F:0.012 (0.011), M:0.022 (0.018), $p<0.00001$). PCA1 was lower in females (F: 0.723 (0.067), M: 0.766 (0.05), $p<0.00001$), while PCA2 (F: 0.139 (0.043), M: 0.127 (0.036), $p<0.01$) and PCA3 (F: 0.049 (0.014), M: 0.041 (0.013),

$p < 0.0001$) were lower in normal males. All indices showed some relationship with age and also age was different among groups, so the following comparisons are corrected for age and gender. The age- and gender-corrected median value of PCA1 was lower in non-MI patients with VT by 0.12 ($p < 0.00001$) compared to normal. In MI patients with VT PCA1 was lower by 0.03 ($p < 0.01$) compared to MI patients without VT. PCA3 was higher, by 0.02 ($p < 0.05$) and 0.01 ($p < 0.00001$) respectively.

PCA1 and PCA3 could also differentiate between VT patients with no previous MI and MI patients without VT, PCA1 being lower in the VT patients (by 0.046, $p < 0.01$) and PCA3 being higher (by 0.007, $p < 0.05$). ERDI was increased in non-MI, VT patients compared to normals by 0.21 ($p < 0.00001$) while LRDI was increased in MI+VT compared to MI without VT patients by 0.009 ($p < 0.01$). The best diagnostic separation for VT in MI was seen for PCA1 (figure 2) and PCA3 in females.

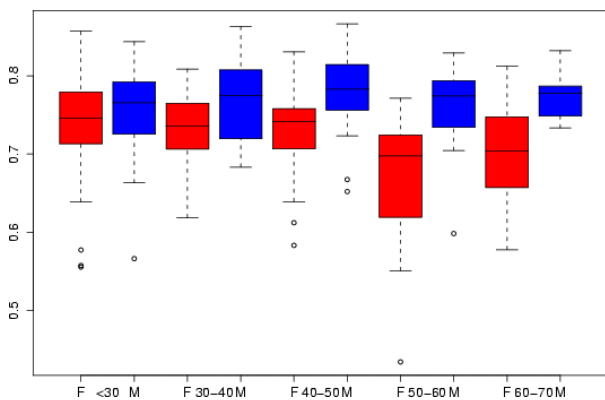


Figure 1. PCA1 by age and gender in the normal subjects subgroup. Boxes extend from the first to the third quartile and are crossed by a line indicating the median of the sample. Blue (darker) boxes represent males of each age group while red boxes represent females.

DISCUSSION. While this study does not prove any independent prognostic value of the repolarization indices compared to other indices (such as low ejection fraction or heart rate variability) it does identify distinctive phenomena at the body surface which are associated with VT and which may be the electrocardiographic expression of arrhythmogenic electrical remodelling of the ventricular myocardium.

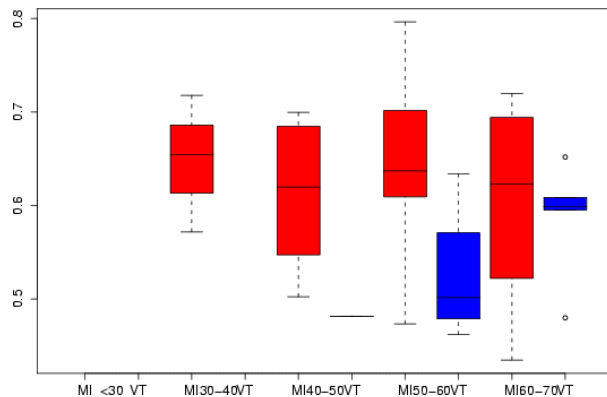


Figure 2. PCA1 by age in females with old MI, with or without history of VT. Blue (darker) boxes represent VT cases. There are no cases of MI in females under 30 and there is a single case of VT history under 50.

The hypothesis that PCA indices are more useful in females than in males and, in general, that different kinds of repolarization indices might be relevant in the two genders should be explored further.

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