Age Dependence of the Vulnerability Index in Young People

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Abstract. *Index of vulnerabilty is a parameter evaluating the risk of arrhythmia development, which is derived from isointegral maps of QRST interval (IIM QRST). Individual characteristics of isointegral maps are influenced by different factors such as age or sex, which contribute to the relatively high variability among measured parameters of IIMs in patients or control subjects. In our study we wanted to establish age dependence of vulnerability index on age when using the same subjects as controls as well as tests. We found a non-significant increase of indexes of vulnerability in the older group of subjects.*

Keywords: Isointegral Map, Index of Vulnerability, Healthy Subjects

1. Introduction

Conditions associated with a higher risk of ventricular arrhythmia could be evident from ST-T segment [1]. Electrocardiographic body surface mapping offers more possibilities for their evaluation. It can be simply the number of extrema in QRST isointegral map (IIM) [2] or more sophisticated, index of vulnerability based on comparison of IIM QRST of a test subject with IIM QRS and IIM ST-T of a control can be used [1].

In an ideal situation, the same subject may serve as a test (under arrhythmic conditions) and as a control (under physiologic conditions). In practice, this is not usually possible. So the result, i.e. the value of vulnerability index, may depend on the choice of the control group.

In our study we wanted to find out whether the vulnerability index changes if we have controls of different age.

2. Subject and Methods

Subjects:

We constructed IIM QRST of 58 young people in age of 18 - 25 years and divided them into two equal groups according to their age (group A: 18 - 19 years (3 women, 26 men), group B: 20 - 25 years (3 women, 26 men)). All of them have no history of cardiovascular disease and ECG without pathological changes. We calculated the vulnerability indexes for each subject, while all other members of their group served as control subjects. For further comparison, the minimal obtained value was taken.

Body surface mapping:

Data for body surface mapping were registered using the limited 24-lead system after Barr [3] and processed using the mapping system ProCardio [4]. Data were registered in supine position. Linear baseline was taken through T-P segments. The onset and offset of the QRS complex was established manually from the root mean square signal [5].

Isointegral maps are distributions of potential time integrals over chosen time intervals [6]. Vulnerability index is calculated using IIM QRST as following: IIM QRST of subject to be tested is compared to all samples of the control group and the best matching map is determined (the map with the smallest total QRST area difference from all leads). The difference between the test map and the best match from the control group is shown as the „vulnerability map“according to following equation:

$$V = IIM\ QRST_{test} - (IIM\ QRS_{control} + \alpha \cdot IIM\ ST\text{-}T_{control}) \quad (1)$$

where α is determined by minimising squared difference:

$$d[V^2] / d\alpha = 0 . \quad (2)$$

Coefficient α has to fulfil the condition:

$$-1 \le \alpha \le 1 \quad (3)$$

Vulnerability index is calculated as the square root of the sum of the squares of all values contained in the vulnerability map

$$VI = (\Sigma V_i^2 / n)^{1/2} , \quad (4)$$

where V_i is the value of vulnerability map in the i-th position, i = 1, 2, …, n.

We evaluated the vulnerability index, value of alpha (optimisation coefficient), and the number of acceptable comparison according to equation (4). We compared both groups using non-paired t-test for normal distributed parameters or we used Mann-Whitney test to compare medians [7].

3. Results

There were no significant differences between groups in any calculated parameter. Mean vulnerability index in group B was slightly higher (11.01 ± 4.06 vs. 10.45 ± 3.42), and median was slightly lower (9.88 vs. 9.92) than in group A. Examples of maps used for calculation are given in Fig. 1 and Fig. 2.

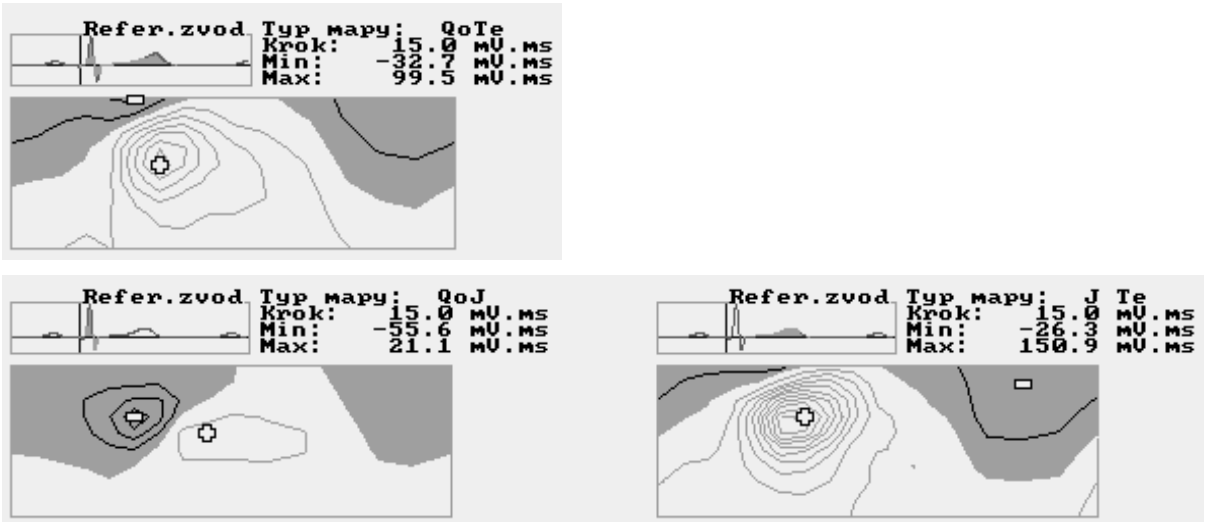

Fig. 1 Isointegral maps corresponding to the lowest vulnerability index obtained in the A group. In the upper row, there is the IIM QRST of the test subject, below it are the IIM QRS and IIM ST-T of the control subject.

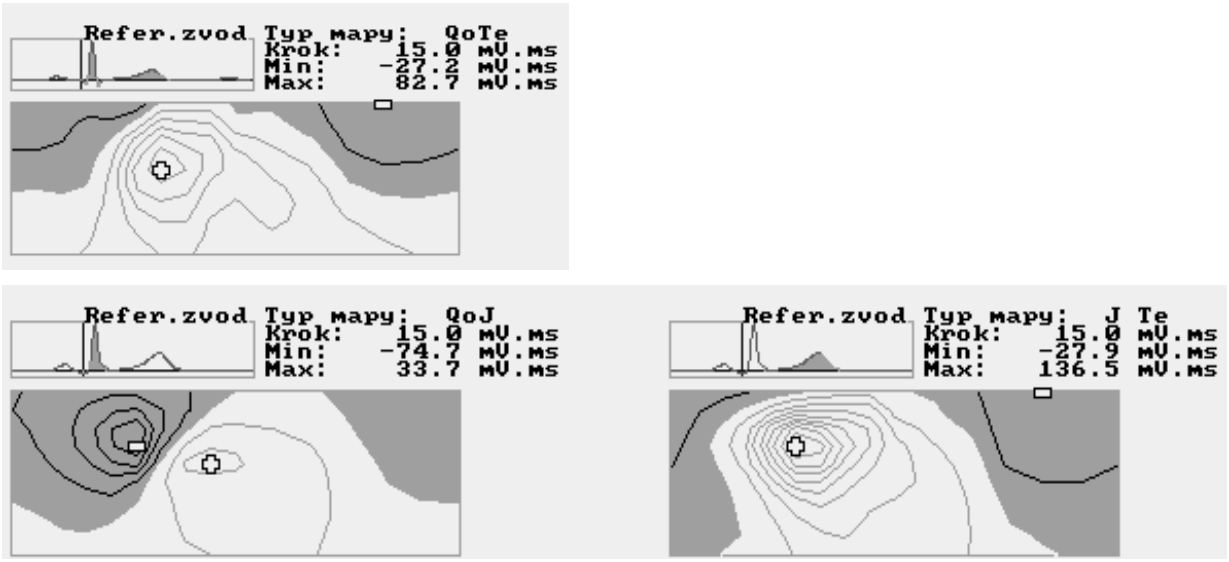

Fig. 2 Isointegral maps corresponding to the highest vulnerability index obtained in the A group. Next description as in fig. 1.

Both mean and median alpha parameter in group B were lower (0.758 ± 0.171 vs. 0.8278 ± 0.1843; 0.810 vs. 0.873) than in group A. Number of acceptable comparisons was 18.9 ± 6.9 (B) vs. 20.4 ± 6.3 (A).

4. Discussion

Subjects for group A were randomly chosen from around 100 subjects to obtain the same number of subjects in both groups. Preliminary results showed that the number of subjects included in the control group may affect the resulting (minimal) value of vulnerability index. Another possibility to solve this problem may be the comparison of average indexes instead of the minimal obtained value.

We found that comparison of groups with different age led to similar results, so that it is possible to use any group as control for measurement of vulnerability index.

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